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ENVIRONMENTAL EFFECTS OF TERMITE CONTROL
INSECTICIDES

FINAL REPORT, PHASE I

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HAZLETON LABORATORIES, INCORPORATED

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A STUDY OF THE ENVIRONMENTAL EFFECTS OF TERMITE CONTROL INSECTICIDES

SUMMARY

A study was conducted to determine residues of termite control insecticides aldrin and dieldrin in the environment of the Tarawa Terrace housing development at Camp LeJeune, North Carolina in December 1965. A major objective of this study was a consideration of hazards to public health that might occur if water treatment systems and watercourses are exposed to termite control insecticides applied to nearby areas and structures.

Samples of soils, water, plants, fish, and algae were obtained for residue analysis by means of electron capture gas chromatography and thin layer chromatography.

There was no direct relationship between levels of aldrin and those of dieldrin (the epoxide of aldrin) in a given soil sample. When the residue levels of aldrin, as well as dieldrin, were compared between upper and lower soil profiles, no definite leaching gradient could be observed. It is necessary that soil samples be obtained from greater depths to provide a better evaluation of leaching.

Insecticide residue levels in general were highly variable. Soils and plants within the treatment area generally contained high

levels of aldrin and/or dieldrin and those outside of the treatment area, particularly downgrade toward nearby creeks, were generally free of these insecticides. A sample of filamentous green algae taken from the headwaters of Frenchman's Creek contained low levels of aldrin and dieldrin, but higher plants, soils, and water taken from this area contained no detectable residues of these insecticides. No other aquatic microorganisma were obtainable.

Water taken from wells in the termite treatment area and from two nearby creeks contained no detectable aldrin or dieldrin.

Flounder caught in Northeast Creek contained no detectable aldrin or dieldrin.

A STUDY OF THE ENVIRONMENTAL EFFECTS OF
TERMITE CONTROL INSECTICIDES

INTRODUCTION

This report completes work on the determination of termite control insecticide residues in various samples collected during the winter of 1965 in the environment of the Tarawa Terrace housing development at Camp LeJeune, North Carolina.

Samples of soil, water, plants, fish, and algae were collected from sites within and peripheral to the termite control treatment area, and transported to Hazleton Laboratories for determination of aldrin and dieldrin residues. Aldrin was originally applied to housing structures for termite control, but is converted to the highly persistent epoxide form, dieldrin, a potent insecticide. Therefore, dieldrin, as well as aldrin residues, are of interest.

BACKGROUND

Insecticide Application

A one-percent water emulsion of the insecticide, aldrin, was applied to foundations of dependents' housing in Tarawa Terrace I and Tarawa Terrace II between October 12, 1963, and April 9, 1964.

The insecticide was applied to eight-inch wide trenches dug to the base of footings of houses at the rate of at least four gallons per 10 cubic feet of trench where the bottom of footings was over 18 inches deep. The above procedures also applied to all interior foundation walls,

piers, piling, and other supports. Soil under slabs on grade, with the exception of sidewalks, porch slabs, and driveways, was treated by drilling holes through outside walls near grade and flooding under pressure. The insecticide was applied to the above structures at the rate of three gallons per 10 square feet of floor area.

On June 18, 1958, a 330 acre area in Tarawa Terrace I and on July 3, 1958, a 377 acre area in Tarawa Terrace II was treated with 10% granular dieldrin at the rate of two pounds of active ingredient per acre for control of fire ants.

In September 1962, a 50-acre area was retreated with 10% granular dieldrin at the rate of two pounds of active ingredient per acre along the east side of Iwo Jima Boulevard, along the south side of Tarawa Boulevard in the area of the Community Building, and peripheral to the woods north of Tarawa Terrace I between Tarawa Boulevard and Iwo Jima Boulevard.

Edaphic Factors

The soil of the area under consideration is classified as a fine sandy loam, with localized lenticular clay deposits scattered through the area. The fine sandy loam extends for a depth of about one foot, underlain by a very fine sand. The limestone parent material is found at depths of 60 to 75 feet. Because of the localized nature of the clay deposits, Public Works officials at Camp LeJeune do not consider the area as a generally impervious one, although the very fine sand component does not permit the degree of water percolation that might be expected for this soil.

The static water level for the area under consideration is at a depth of 10 to 12 feet. Wells in the area extend to depths of about 100 feet.

Climatic Factors

The average monthly temperature and the total monthly precipitation for the Camp LeJeune area between 1960 and 1965 was provided by the Weather Officer, Marine Corps Air Facility, New River, North Carolina, and is presented in Table No. 1.

EXPERIMENTAL PROCEDURE

Sample Collection

Following a site visit to familiarize the investigator with the area to be sampled for insecticide residues, samples of soil, water, plants, fish, and algae were collected for determination of aldrin, dieldrin, DDT, and DDT metabolites. Soils were collected at 31 sites adjacent to foundations of houses within the general treatment areas and from locations peripheral to the treatment areas. At each site, soil cores were taken in triplicate from the upper one-foot profile and from the lower one-foot profile at about the three-foot level, amounting to six samples per site.

Bottom mud samples were taken in triplicate from nine sites along Northeast Creek and Frenchman's Creek at the shoreline and about 20 yards offshore.

Plant sampling was generally restricted to the frost-hardy grasses. Plant samples were collected from 16 sites within and outside of the areas of insecticide application. Because of "winter-kill," no broad-leaved annuals were collected. Likewise, broad-leaved perennials had lost their leaves prior to collection and, therefore, were not sampled. Occasionally, chickweed and Plantain which are winter-hardy in the mid-Atlantic states, were seen and samples were taken. Of the plants collected, sample sizes were rather small; therefore, plant samples for each collection site were pooled and no attempts were made to separate root and foliar portions.

Filamentous green algae were found in a small pool in the headwaters of Frenchman's Creek. The amount of algal growth precluded triplicate sampling, so a single sample was collected for residue analysis.

Only one species of fish, flounder, was collected from Northeast Creek. Nine individuals were retained for wholebody residue determinations. No minnows or related fish species were seen. Preliminary attempts to collect aquatic crustaceans revealed that winter populations were not adequate to obtain samples for insecticide residue determinations.

Water samples were collected in triplicate from each of three wells within the Tarawa developments. Other samples were collected from 11 sites along Northeast Creek and Frenchman's Creek. Sampling consisted of triplicate collection of water from near the shoreline and from about 20 yards offshore. In offshore sampling, triplicate collections were taken each from the surface and from near the bottom.

Residue Determinations

The residue analytical methods used in this program were taken from Volume I of the Pesticide Analytical Manual published by the Food and Drug Administration.

Moisture Determinations:

Moisture determinations were made on the soil and plant samples and these residue values are generally reported on a dry weight basis. The samples were dried by heating in an air oven at 110° C. for 15 to 20 hours. The subsamples taken for moisture determinations were discarded and fresh material taken for the pesticide residue analyses if sufficient sample was available.

Extraction of Pesticides:

Water Samples - From 300 to 500 ml. of each water sample were extracted with a total of 100 ml. of petroleum ether after the addition of 10 ml. of a saturated sodium chloride solution. The petroleum ether extract was dried by passing through a two-inch column of anhydrous sodium sulfate and concentrating to about 10 ml. prior to the Florisil cleanup step.

Soil Samples - Soil samples containing insufficient moisture were conditioned overnight prior to extraction with the amount of distilled water required to raise their moisture content to 20%. Twenty grams (dry weight) of each sample were then extracted with 200 ml. of a 1:1 hexane:acetone mixture by mixing at high speed in a blender for four minutes. The organic extract was then filtered through a plug of

glass wool into a separatory funnel containing 600 ml. of distilled water and 10 ml. of a saturated sodium chloride solution. After mixing and separating the aqueous phase, the organic layer was washed twice with 100 ml. of water containing 5 ml. of sodium chloride solution. The organic layer was then dried by passing through a two-inch column of anhydrous sodium sulfate and concentrated to about 10 ml. for the Florisil column cleanup step.

Plant Samples - A maximum of 50 grams (dry weight) of the chopped plant samples was extracted by mixing at high speed in a blender for two minutes with 200 ml. of acetonitrile. The acetonitrile was filtered through a plug of glass wool into a separatory funnel and 100 ml. of petroleum ether, 10 ml. of saturated sodium chloride solution, and 600 ml. of distilled water added. The aqueous layer was separated and discarded after gently mixing; the organic layer was then extracted twice with 100 ml. of water. The organic phase was dried by vigorous shaking with 15 grams of anhydrous sodium sulfate and concentrated to about 10 ml. prior to Florisil column cleanup.

Fish Samples - The fish samples were thoroughly hemogenized and a 25 gram portion ground with anhydrous sodium sulfate. The samples were extracted by vigorous shaking with 100 ml. of petroleum ether and then centrifuged to separate the extract. The residue was re-extracted with two 50-ml. portions of petroleum ether. The combined ether extracts were evaporated and a maximum of 3 grams of fat taken for acetonitrile partitioning.

<u>Acetonitrile Partitioning</u> - The extracted fat was transferred to a 125-ml. separatory funnel using small portions of petroleum ether until a total volume of 15 ml. was collected. A 30-ml. portion of acetonitrile (saturated with petroleum ether) was added to the separatory funnel and the mixture was shaken vigorously for one minute. The lower layer of acetonitrile was separated and drained into a one-liter separatory funnel containing 200 ml. of a 2% sodium chloride solution and 100 ml. of petroleum ether. The petroleum ether solution in the 125-ml. separatory funnel was extracted three more times with 30-ml. portions of acetonitrile. These extracts were then added to the one-liter separatory funnel; the funnel was swirled (cautiously to minimize emulsions) and the aqueous layer drained off into a second one-liter separatory funnel. The aqueous layer was re-extracted by mixing vigorously with another 100-ml. portion of petroleum ether. The combined petroleum ether extracts were washed two times with 100-ml. portions of 2% sodium chloride solution and transferred to Kuderna-Danish evaporative concentrators after being passed through a two-inch column of anhydrous sodium sulfate. The one-liter separatory funnel and the sodium sulfate column were washed with three 10-ml. portions of petroleum ether. The combined volume of petroleum ether was evaporated to 10 ml. for further cleanup by Florisil column chromatography.

<u>Florisil Column Chromatography</u> - A one-half inch layer of anhydrous sodium sulfate was added to a four inch column of activated Florisil in a 25 mm. O.D. x 300 mm. chromatographic tube. After

prewetting the column with 40 ml. of petroleum ether, the concentrated petroleum ether extract of the sample was added and the solution was allowed to flow through the column at a rate of not more than 5 ml/minute. The vessel containing the extract was rinsed with two 5-ml. portions of petroleum ether which were added to the column and then 200 ml. of a "6 + 94" mixture of ethyl ether and petroleum ether was used to elute the column. A second fraction was collected at the same flow rate using 200 ml. of a "15 + 85" solution of these solvents. The two fractions from each sample were then concentrated to less than 5 ml. using Kuderna-Danish evaporative concentrators. These fractions were then used for the determination of chlorinated pesticide residues by electron capture gas chromatography.

Electron Capture Gas Chromatography - The injection of a 5-mg. sample portion was necessary to obtain the sensitivity required for these analyses. Dilutions were made, when required, using n-heptane to bring each pesticide peak on scale. Standards were run with each fraction of each sample in order to insure accurate qualitative analysis as well as to quantitate each pesticide as specified.

Verifications by Thin Layer Chromatography - A number of samples were verified by thin layer chromatography using the method of M. F. Kovacs, JAOAC 46, 884, 1963. The identities of aldrin, dieldrin, p,p'-DDT, p,p'-DDD were established in several samples using this technique.

Solvents and Reagents - High purity and reagents were used throughout this program. Special "high grade" solvents were obtained

from Burdick and Jackson or Mallinckrodt or were purified by distillation in our laboratories. Frequent blanks were run to maintain quality control on the reagents. The Florisil used for the column cleanup was carefully activated and periodically checked using a standard pesticide mixture.

RESULTS

General

Tables No. 2 and No. 3 show insecticide residue determinations for the indicated samples collected within and peripheral to Tarawa Terrace I and Tarawa Terrace II, respectively. Figures No. 1 and No. 2, respectively, facing the above tables, show locations of the various sampling sites.

Soil Residues

Soil Samples Adjacent to Treated Foundations:

Soil samples collected adjacent to the foundations of structures treated with aldrin were highly variable in residues of this insecticide and its epoxide, dieldrin. There was no direct relationship between the concentration of either insecticide in the upper one-foot section of a given three-foot soil core and that in the lowermost one-foot section of the core. There was no direct correlation between the level of aldrin and its epoxide, dieldrin, among replicates at a given soil depth.

Soils Distant from Treated Structures and Areas:

Residues of aldrin and dieldrin in soil samples such as Numbers 19, 21, 41, and 88, taken from sites at a distance from treated structures within the housing areas, and samples such as Numbers 8, 31a, 44, and 45, taken from outside the housing areas, were much less variable than the residues in soils adjacent to treated foundations. Moreover, in the above samples containing dieldrin and/or aldrin, the insecticides were at a very low level, relative to levels in soils adjacent to treated foundations. In some samples no aldrin or dieldrin was detected, and this will be discussed later.

Bottom Mud from Northeast Creek and Frenchman's Creek:

Aldrin and dieldrin generally were not detected in mud taken from the shoreline and 20 yards offshore on Northeast Creek and Frenchman's Creek. In the bottom sample taken about 20 yards offshore at the opening of the sewage disposal plant outfall on Northeast Creek (Sample 60), low levels (0.06-0.28 ppm) of dieldrin were found, but no aldrin was detected.

Residue Determinations in Plants

Whole-plant residues of aldrin and dieldrin were determined on plants collected within the housing development and from various sites peripheral to the development and near the aforementioned creeks. Plants within the termite treatment areas generally had appreciable levels of aldrin and dieldrin. (See Samples No. 80, 81, 82, 83, 86, 87, 89, 90; Tables No. 2 and No. 3). A sample of perennial grass (No. 90) contained particularly high levels of aldrin (450-580 ppm) and

dieldrin (63-92 ppm). Perennial grass collected from a drainage area behind a group of houses in Tarawa Terrace II (Sample No. 89) contained moderately high aldrin (40-44 ppm) and dieldrin residues (38-46 ppm). Plantain and chickweed (Sample No. 80) taken from behind a group of houses in Tarawa Terrace I contained 80 ppm of aldrin and 24 ppm of dieldrin.

No aldrin or dieldrin was detected in higher plants collected downgrade from the housing areas and near the two creeks, with the exception of one sample, No. 78, collected around Sewage Lift Station No. 1 (See Table No. 2.) No aldrin was detected, but residues of 0.08 to 0.09 ppm of dieldrin were detected.

The sample of filamentous green algae collected from a pool in the headwaters of Frenchman's Creek contained 0.03 ppm of aldrin and 0.03 ppm of dieldrin. (See Sample No. 75, Table No. 3 and Figure No. 2.)

Water

Samples of water taken from three wells within the general termite treatment area contained no detectable aldrin or dieldrin (Samples No. 70, 71, and 72; Table No. 2, and Figure No. 1).

Water collected from the surface and from near the bottom along Northeast Creek and Frenchman's Creek contained no detectable aldrin or dieldrin. These results were negative without exception and they are not included in the tables. However, these sampling sites are included in Figures No. 1 and No. 2.

Fish

Nine flounder were caught in Northeast Creek and whole-body insecticide residue analyses were conducted. No detectable aldrin or dieldrin was found in any of the samples; therefore, these results are not presented in tabular form.

DISCUSSION

Variability in Levels of Aldrin and Dieldrin Residues

Residue values reported herein for aldrin and dieldrin show wide variations among replicates of certain samples. The method of replicating soil samples taken from treated dwellings may reflect non-uniform exposure of the soil to the insecticide during treatment operations. Insecticide spillage during tank filling, "rodding-in" of beam end-walls and trenching may have contributed to observed non-uniformity. Each soil replicate was taken from near the base of three respective walls of a given structure and packaged separately for residue analysis.

A few values for certain sites are presented as examples of the variability encountered among replicates. At Site No. 2, aldrin residues in three replicates taken from the upper one-foot soil level amounted to 9.0, 52 and 1600 ppm, respectively. Aldrin residues at the three-foot level were less disparate, amounting to 3.2, 1.2 and 8.0 ppm in respective replicates. Although dieldrin residues generally were less variable than those of aldrin, values for the former showed instances of disparity. At Site No. 10, dieldrin residues in soil at the three-foot level were 51, 0.49 and 9.0 ppm in respective replicates.

Aldrin and dieldrin residues in soils taken at a distance from the termite treatment area were of low variability. In fact, Samples No. 44 and No. 45, taken near Frenchman's Creek, uniformly showed no detectable residues. Sample No. 8, taken peripheral to Tarawa Terrace I, contained uniformly low levels of aldrin and dieldrin.

Edaphic and Ecological Factors

Lichtenstein and Schultz (1) found that the persistence of aldrin applied to soils was influenced by soil type and by soil temperature. It was found that the rate of loss of aldrin under field conditions was greatest during the first six months following application, though less in a muck soil (40.0% organic matter). Half of the originally applied aldrin had disappeared from the muck soil 3.75 months after application and 2.4 months following application to the Miami silt loam. Three and one-half years following application, 4.7 percent of the originally applied aldrin was recovered from the muck soil and 1.1 percent was recovered from the Miami silt loam.

The above authors also tested the persistence of aldrin under laboratory conditions at 26 degrees Centigrade, following application at a rate of 200 lb/six-inch acre to a muck soil, Miami silt loam and Plainfield sand (0.8% organic matter). After 56 days, 87.5 percent of the initially applied insecticide remained in the muck soil, 68.9 percent in the Miami silt loam, and 54.5 percent in the Plainfield sand.

These authors also conducted laboratory studies to evaluate effects of soil temperature and application rate on the rate of loss of aldrin from two soil types 56 days after application. When a Miami silt loam was tested at a rate of 20 lb/six-inch acre, 83.8 percent of the original material remained when incubated at six degrees centigrade (37 degrees Fahrenheit), 55.7 percent remained at 26 degrees Centigrade (79 degrees Fahrenheit), and 13.7 percent remained at 46 degrees Centigrade (115 degrees Fahrenheit). When a Plainfield sand was treated at a rate of 100 lb/six-inch acre, 63.0 percent of the original material remained at six degrees Centigrade (37 degrees Fahrenheit), 38.0 percent remained at 26 degrees Centigrade (79 degrees Fahrenheit) and 10.2 percent remained at 47 degrees Centigrade (117 degrees Fahrenheit). Therefore, it can be seen that the loss of aldrin was greater at all three temperatures in the Plainfield sand than in the loam.

However, these depletion studies for aldrin can be misleading from the standpoint of toxicant residues in soils. Edwards et al[2] and Gannon and Bigger[3] showed that aldrin is converted to dieldrin in soils. Lichtenstein and Schulz[4] reported that four years after treatment of field plots with aldrin at a rate of 20 lb/six-inch acre, six times more dieldrin than aldrin (0.84 vs. 0.14 ppm) was found in a Miami silt loam, and 12.6 times more dieldrin than aldrin (1.01 vs. 0.08 ppm) was recovered from a sandy loam. When aldrin was applied to these plots at a rate of 200 lb/six-inch acre, 62.8 ppm of aldrin and

19.3 ppm of dieldrin were detected four years after treatment of a muck soil. However, a sandy loam contained 5.65 ppm of aldrin and 15.30 ppm of dieldrin four years after aldrin application at the above rate. A Miami silt loan treated as above contained 3.69 ppm of aldrin and 5.02 ppm of dieldrin four years after aldrin treatment. The above results indicate that some of the aldrin applied to soils at known rates is converted to dieldrin, the degree of conversion being governed to some extend by soil type and temperature.

It has also been shown that aldrin is converted to dieldrin on plants[5]. In addition, Glasser[6] presented evidence for the conversion of aldrin to dieldrin on carrots grown in aldrin-treated beds.

Because of the treatment of the housing area in 1958 and 1962 with granular dieldrin for fire ant control, any quantitative discussion of the fate or depletion rates of aldrin applied in 1963 and 1964 for termite control would be at best only presumptive, and would necessarily bear the assumption that aldrin application rates to housing foundations closely corresponded with those requested of the termite treatment contractor.

The data for aldrin and dieldrin residues in soils within the termite treatment areas show that dieldrin, as well as aldrin, was generally found between two and three feet below the soil surface. The base of many footings was at 18 inches and lower. Since trenching operations consisted of an application of aldrin to the bottom of these trenches, it cannot be concluded that the occurrence of aldrin and

dieldrin residues in the three-foot soil samples was due only to leaching from soil surfaces. A determination of residues at a level lower than three feet would provide more information on vertical leaching of dieldrin and the parent material, aldrin.

It was not practicable with existing equipment to probe the static water table in the housing area; therefore, no samples of soil or water were obtained from this level. Analyses of soils at a depth of four feet or more should be conducted.

Residue analyses of soils outside of the termite treatment area indicate that, generally, little if any horizontal translocation of the insecticides had occurred.

Appreciable quantities of aldrin and dieldrin were found in plant samples obtained within the termite treatment area. These data agree with the previously discussed reports on the conversion of aldrin to dieldrin in plants. Comparison of residues in plant samples with those of soils in the same area indicate that plants accumulate aldrin to concentrations above those of the ambient environment. Because root and foliar portions of each plant sample were combined due to limited material during the winter collection effort, it is not possible to determine whether aldrin and/or dieldrin accumulated in only the roots or throughout the plant. It is necessary to determine if the insecticides accumulate in plant foliage, in view of the presence of abundant herbivorous animals such as deer, rabbits, and squirrels in the area.

The presence of aldrin and dieldrin in filamentous algae (Sample No. 75) collected from an area in which no detectable aldrin or dieldrin

residues were found in other samples, is an example of the generally known ability of algae to accumulate certain materials from the environment. As expected, populations of microflora and microfauna of waterways sampled during the winter season were low; therefore, no general conclusions on aldrin and dieldrin uptake by these members of the aquatic biome of this area are possible.

Residues in mud samples taken along Northeast Creek and Frenchman's Creek in the vicinity of the Tarawa housing development indicate that aldrin and dieldrin were not generally translocated to this part of the aquatic environment. The presence of dieldrin in the mud sample (No. 60) taken from near the Sewage Treatment Plant outflow is unexplained.

Climatological Factors

No reports have been obtained on the effect of precipitation on persistence of these insecticides, although losses of aldrin and rates of conversion of aldrin to dieldrin have been shown to be influenced by temperature[(1)]. Likewise, there are no known studies on the effect of precipitation on translocation of aldrin and dieldrin in soils. Residue data in Tables No. 2 and No. 3 for soil sampling sites within the general treatment area but at a distance from treated buildings (Samples No. 4, 19, 21, 28, 31a, and 41) allow no conclusions on leaching of aldrin and dieldrin in the fine sandy loam of the area. In some samples both aldrin and dieldrin residues were found at the lower soil depth; in others only one of the residues was found; and, in others, neither was found. The meterological data of Table No. 1 show that, in general,

there was normal precipitation, and no prolonged drought periods occurred since the termite control program was conducted. If aldrin and dieldrin were translocated in surface run-off waters, then residues generally would have been found in soils downgrade from the housing development toward the streams. This was not the case.

Although the mean monthly temperature data in Table No. 1 and residue data in Tables No. 2 and No. 3 do not permit an evaluation of the effect of soil temperature on the aldrin/dieldrin conversion, it is generally agreed that summer soil temperatures have reached sufficiently high levels to accelerate the conversion of aldrin to dieldrin at and near the surface of soils in the housing development.

Toxicological Factors

As discussed earlier, aldrin is converted to the epoxide, dieldrin, following application to soils. The conversion results in a material that, in addition to being highly toxic to insects, has much greater residual properties than the parent material(3). Aldrin has also been shown to be converted to dieldrin in animals as well as in soils and plants(7). Therefore, the toxicity of dieldrin, as well as that of aldrin, is pertinent to a discussion of these materials in terms of residue levels found in this study.

The only record of acute oral toxicity of aldrin in humans was an instance in which a 23-year old man intentionally imbibed an amount of aldrin equivalent to 25.6 mg/kg of body weight. Generalized convulsions, E.E.G. changes, hematuria and albuminuria were noticed following the above exposure. There was a complete recovery(8).

Aldrin exerts its primary effect on the central nervous system. In acute poisoning, this is the mechanism of death. Following several high doses, symptoms of central nervous system stimulation are also noticed. Repeated doses at lower levels give rise to liver damage and, in this respect, young dogs are more susceptible than rats(9). Results of one long-term feeding study in rats indicated that aldrin may have tumorigenic properties(9).

In terms of acute oral toxicity, aldrin has an LD_{50} of 38 to 54 mg/kg body weight in male rats, and 46 to 67 mg/kg body weight in female rats(10,11,12,13,14). In dogs, the LD_{50} following oral administration is 65 to 95 mg/kg body weight(10,11). Quail and pheasants died following dietary intake of 5 ppm aldrin(15).

Cattle fed aldrin at 5 ppm in the diet for 16 weeks had a maximum fat content of 8 ppm of aldrin; those fed 25 ppm for eight weeks accumulated 78 ppm in the fat. Sheep fed 5 ppm of aldrin in the diet for 16 weeks accumulated 17 ppm; those fed 25 ppm for eight weeks accumulated 78 ppm in the fat(16). All of the above dietary levels were harmless to the health of the animals.

The maximum nontoxic dose and minimum toxic dose found in oral administration tests on aldrin in one- to two-week old calves were 2.5 to 5.0 mg/kg body weight, respectively. The values for adult cattle were 10 and 25 mg/kg body weight, respectively; and for adult sheep, 10 and 15 mg/kg body weight, respectively.

A no-effect level for aldrin has not been found in rat and dog studies; the acute and chronic toxicity tests do not permit the estimation of an acceptable dietary intake for man(9).

Dieldrin, being a primary metabolite and epoxidation product of aldrin, has the same mode of action and symptomatology, and may have the same tumorgenic properties as the latter[9].

Following oral administration in acute toxicity studies, the LD_{50} for rats was shown to lie between 37 and 87 mg/kg body weight[10,11,12,13,17,18]. The LD50 for dogs following oral administration was found to be between 56 and 80 mg/kg body weight and, for sheep, between 50 and 75 mg/kg body weight[10,11].

When cattle were fed dieldrin at a dietary level of 10 ppm for 16 weeks, 44 ppm had accumulated in fat, and when fed 25 ppm for eight weeks 75 ppm had accumulated[16]. Sheep fed 10 ppm of dieldrin in the diet for 16 weeks had accumulated 48 ppm in the fat, and when fed 25 ppm for eight weeks, had accumulated 69 ppm in the fat[16]. The above levels were harmless to the animals.

The maximum nontoxic dose and minimum toxic dose found when dieldrin was administered orally to one- to two-week old calves was five and 10 mg/kg body weight, respectively. When adult cattle were tested, the values were 10 and 25 mg/kg body weight, respectively. When adult sheep were tested, the same respective values as those for adult cattle were found[16].

As with aldrin, the toxicological studies reported on dieldrin do not permit the estimation of an acceptable daily intake for man[9].

In the United States, however, a tolerance of 0.25 ppm has been established for both aldrin and dieldrin residues on agricultural

products representing about 25% of the daily dietary intake of man and this could contribute about 0.06 ppm of aldrin or dieldrin to the total diet[19]. In addition, a 0.1 ppm tolerance has been set for these two insecticides on agricultural products representing about 50% of the dietary intake, which could add 0.05 ppm, amounting to a total of 0.11 ppm of either insecticide in the daily diet[19]. However, research on these residues in the total diet indicate that the above value is reduced in the magnitude of 0.003 ppm [20].

Aldrin and dieldrin tend to accumulate in fat tissues of animals fed these compounds, and Treon and Cleveland[14] showed in separate three-generation rat reproduction studies with individuals fed 2.5, 12.5, and 25 ppm of aldrin and dieldrin that all levels reduced survivors among suckling young. In addition, Ely et al [21] showed that appreciable levels of deildrin are excreted in the milk of cows fed alfalfa that was sprayed with the insecticide. Therefore, a pathway for magnification and transmittal of aldrin and dieldrin from mammalian parents to offspring does exist. As discussed previously, appreciable residues of aldrin and dieldrin were found in certain plant samples within the general termite control treatment area, and the potential for appreciable accumulation of these insecticides among fauna feeding in the area under consideration cannot be disregarded until determinations can be made of the residues in the various mammalian species there.

Moreover, an incomplete spectrum of food-chain organisms existed when the winter environment of the Tarawa Terrace Housing Development was sampled. Discontinuity in the terrestrial and aquatic food-chains

could be largely overcome by collecting samples during warmer months when biome populations are at relatively high levels. Such sampling would enhance assessment of the transfer potential of termite insecticides in food-chains.

Expanded sampling of the soil profile and the static water level are necessary to improve evaluation of vertical and horizontal translocation of termite insecticides in the soil.

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Table No. 1 - Climatological Summary 1960-1965 - Weather Service Division, Operations Department, Marine Corps Air Facility, New River, Jacksonville, North Carolina 28540 *

Average Monthly Temperature (^{o}F)

	January	February	March	April	May	June	July	August	September	October	November	December	Average
1965	45	46	50	61	72	75	77	79	74	62	-	-	-
1964	45	44	54	62	70	77	77	77	73	59	57	50	62
1963	41	45	61	66	69	78	79	80	72	68	54	39	63
1962	46	53	52	64	75	76	82	79	74	68	54	45	64
1961	43	51	61	59	70	77	83	80	78	67	59	50	65
1960	48	49	45	67	68	79	81	81	76	68	59	43	64

Total Monthly Precipitation (Inches)

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1965	1.96	5.77	5.71	1.31	5.66	11.78	8.42	3.93	1.40	1.48	-	-	-
1964	7.58	7.70	1.76	6.19	4.36	4.77	9.81	7.42	6.21	5.27	2.16	4.01	69.23
1963	1.64	3.17	1.55	1.42	3.09	1.73	3.10	4.60	2.62	3.91	6.54	3.35	36.72
1962	3.60	2.66	3.88	5.30	2.24	6.56	4.92	6.04	2.39	3.18	4.22	1.65	46.64
1961	.59	4.43	5.43	5.59	4.18	4.69	3.01	5.78	4.71	.48	1.18	1.20	41.33
1960	2.88	5.62	4.45	2.50	5.10	1.71	6.45	3.80	8.00	2.33	2.15	2.12	47.11

*P.V. Kosmo, Weather Officer, Weather Service Division, Operations Department Marine Corps Air Facility, New River, Jacksonville, North Carolina

Table No. 2 - Aldrin and Dieldrin Residues in Soils and Plants, Tarawa Terrace I, Dry Weight Basis

SAMPLE NUMBER	INSECTICIDE (ppm) ALDRIN REPLICATE 1	ALDRIN 2	ALDRIN 3	DIELDRIN REPLICATE 1	DIELDRIN 2	DIELDRIN 3	AVERAGE MOISTURE CONTENT OF SAMPLE %
1 (1)*	ND***	3.8	4.6	0.37	1.7	5.3	7.5
1 (3)**	ND	0.09	0.07	ND	0.14	0.05	14
2 (1)	9.0	52	1600	8.0	21	40	6.1
2 (3)	3.2	1.2	8.0	2.8	1.0	2.8	7.6
3 (1)	1.3	100	1.5	1.3	5.5	1.3	7.6
3 (3)	ND	38	2.3	ND	5.6	0.08	7.0
4 (1)	0.43	0.05	0.08	0.05	ND	ND	27
4 (3)	0.46	ND	ND	ND	ND	ND	20
5 (1)	ND	ND	130	0.36	0.07	6.7	8.6
5 (3)	ND	ND	4.5	ND	ND	0.48	11
6 (1)	26	49	27	8.1	8.5	5.2	11
6 (3)	0.21	54	3.4	0.06	6.0	0.62	12
8 (1)	0.41	0.22	0.05	0.73	0.05	ND	35
8 (3)	0.69	0.06	0.05	0.29	ND	ND	43
9 (1)	3.0	ND	31	1.2	0.63	7.0	12
9 (3)	6.7	ND	ND	0.77	ND	0.40	18
10 (1)	770	30	33	18	2.5	9.5	5.8
10 (3)	230	9.0	7.0	51	0.49	9.0	13
11 (1)	84	150	350	2.4	7.4	4.6	9.5
11 (3)	1.5	150	130	1.4	4.7	3.0	11
19 (1)	0.24	0.12	0.12	0.54	0.27	0.09	10
19 (3)	0.18	ND	0.06	ND	ND	ND	12
21 (1)	ND	ND	0.06	0.45	ND	ND	14
21 (3)	ND	ND	ND	ND	ND	ND	15
47	ND	ND	ND	ND	0.05	ND	36
50	ND	ND	ND	ND	ND	ND	67
52	ND	ND	0.06	ND	ND	ND	84
78	ND	ND	ND	0.08	0.08	0.09	75
79	ND	ND	ND	ND	ND	ND	78
80	80	80	80	24	24	24	54
81	0.12	0.10	0.11	3.8	3.9	4.0	35
82	ND	0.05	ND	0.24	0.26	0.26	35

* Sample from upper one foot of a three-foot core
** Sample from lower one foot of a three-foot core
*** "ND" - Not detected; limit of detectability, 0.05 ppm

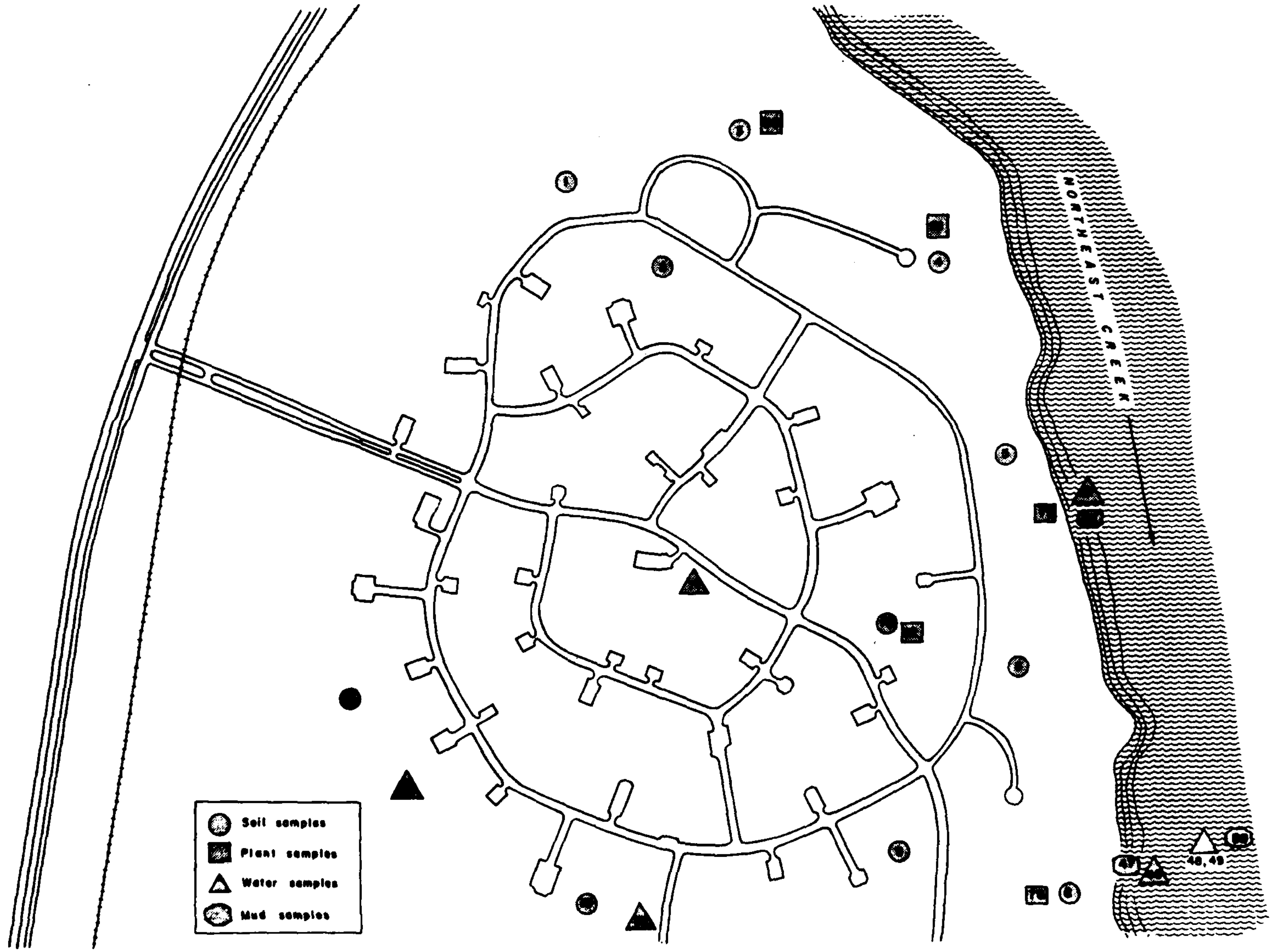
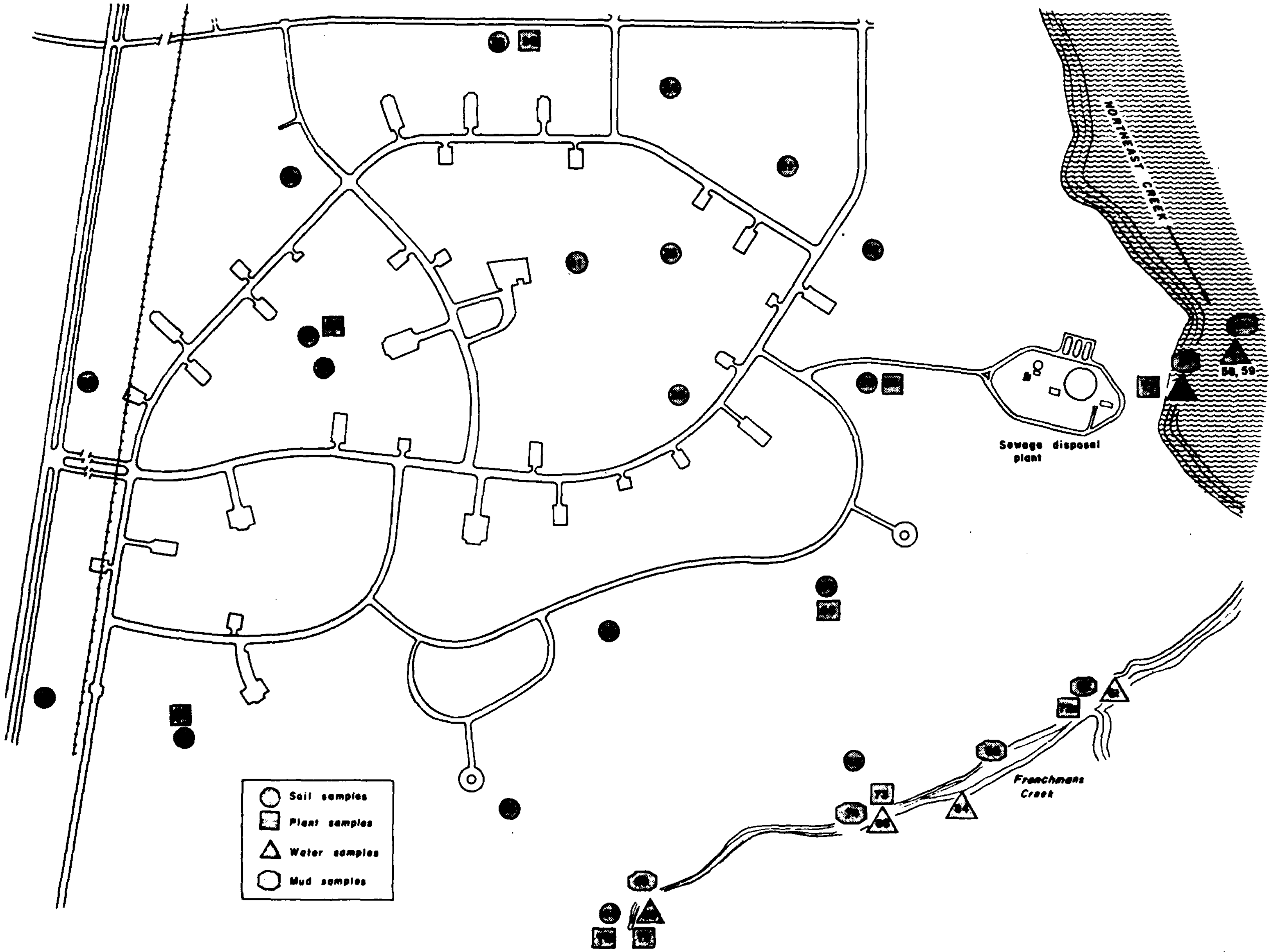


Figure No. I – Sampling sites for collection of soil, water, mud and plants, – Tarawa Terrace I

Table No. 3 - Aldrin and Dieldrin Residues in Soils and Plants, Tarawa Terrace II, Dry Weight Basis

SAMPLE NUMBER	INSECTICIDE (ppm) ALDRIN REPLICATE 1	2	3	DIELDRIN REPLICATE 1	2	3	AVERAGE MOISTURE CONTENT OF SAMPLE %
22 (1)*	32	55	0.06	3.9	6.5	0.65	11
22 (3)**	1.2	1.5	0.12	0.31	0.34	ND***	15
23 (1)	110	130	3.1	4.3	6.8	0.81	9.6
23 (3)	1.7	8.3	0.05	0.28	1.5	ND	12
24 (1)	0.12	340	120	1.8	4.8	9.6	3.7
24 (3)	0.26	9.0	36	0.45	0.52	1.9	4.2
25 (1)	23	120	0.06	8.1	5.0	0.35	10
25 (3)	0.13	90	0.19	0.46	2.0	ND	11
26 (1)	11	320	365	6.6	7.0	14	10
26 (3)	5.2	130	90	0.51	7.1	3.8	11
28 (1)	0.48	0.11	0.11	ND	0.32	0.09	14
28 (3)	0.14	0.85	ND	0.22	ND	ND	16
29 (1)	8.3	1.4	42	9.4	5.2	6.5	12
29 (3)	0.13	0.26	ND	0.58	0.07	ND	13
30 (1)	2.7	230	500	2.3	8.0	60	8.0
30 (3)	3.9	8.0	15	0.83	0.40	6.5	12
31 (1)	45	17	51	18	8.4	15	13
31 (3)	54	0.48	4.8	2.6	0.30	2.0	16
31a(1)	0.25	ND	0.11	ND	ND	ND	11
31a(3)	ND	0.14	0.10	ND	ND	ND	8.9
32 (1)	410	190	18	100	12	2.5	14
32 (3)	220	200	6.5	16	4.4	1.7	15
33 (1)	0.37	230	470	0.68	6.6	13	12
33 (3)	0.27	0.18	0.85	0.09	ND	0.23	16
34 (1)	95	140	37	2.1	13	3.0	8.3
34 (3)	16	3.0	0.06	0.32	0.15	ND	8.7
35 (1)	1.0	28	5.2	2.5	3.8	2.7	17
35 (3)	0.09	0.05	0.07	0.05	ND	ND	14
36 (1)	0.70	310	0.40	1.0	19	0.05	15
36 (3)	ND	0.06	1.2	ND	0.45	ND	17
41 (1)	0.19	26	46	0.95	7.5	11	7.9
41 (3)	2.7	ND	2.0	1.4	0.92	0.90	7.5
44	ND	ND	ND	ND	ND	ND	27
45	ND	ND	ND	ND	ND	ND	9.6
88 (1)	0.65	ND	0.25	0.71	0.36	1.08	20
88 (3)	0.05	0.06	ND	ND	0.15	0.06	37
57	ND	ND	ND	ND	ND	ND	20
60	ND	ND	ND	0.15	0.06	0.28	81
62	ND	ND	ND	ND	ND	ND	42
69	ND	ND	ND	ND	ND	ND	32
74	ND	ND	0.06	ND	ND	ND	73
85	ND	ND	ND	ND	ND	ND	69
72a	ND	ND	ND	ND	ND	ND	78
73	ND	ND	ND	ND	ND	ND	65
75	0.03	--	--	0.03	--	--	99
76	ND	ND	ND	ND	ND	ND	42
77	ND	ND	ND	ND	ND	ND	50
83	0.11	0.05	0.70	2.2	2.8	3.4	45
86	3.8	5.8	5.0	4.1	4.0	4.7	51
87	ND	ND	ND	0.98	1.1	1.2	46
89	44	40	44	46	38	44	35
90	580	500	450	92	74	63	40

* Sample from upper one foot of a three-foot core
** Sample from lower one foot of a three-foot core
*** "ND" - Not detected; limit of detectability, 0.05 ppm



NORTHEAST CREEK
58, 59
Sewage disposal plant
73
64
66
Frenchmans Creek
Soil samples
Plant samples
Water samples
Mud samples

A P P E N D I X   A

Description of sites sampled during collection in December 1965.

SOIL SAMPLE NO.	DESCRIPTION
Tarawa Terrace I	
1	933 E. Peleliu Drive
2	1010 E. Peleliu Drive
3	1615 Cape Gloucester Circle
4	Orote Place (South of No. 3, see map)
5	1061 E. Peleliu Drive
6	1099 E. Peleliu Drive
8	Sewage Lift Station No. 1 (off boardwalk)
9	658 W. Peleliu Drive
10	506 W. Peleliu Drive
11*	392 W. Peleliu Drive
19	233 Tarawa Boulevard (ditch area behind)
21	Lawn behind shopping center
Tarawa Terrace II	
22	2450 Tarawa Boulevard
23	3313 Haguru Drive
24	3369 Haguru Drive
25	3407 Haguru Drive
26	3532 Hungnam Place (Chosin Circle)
28	3265 Guam Drive (about 650 ft. N.W. Agana Place)
29	3179 Bougainville Drive
30	2517 Bougainville Drive
31**	2606 Bougainville Drive
31a	Area about 700 yards behind 2619 Bougainville Drive
32	2653 Bougainville Drive
33	2733 Bougainville Drive
34	2811 Bougainville Drive
35	2842 Bougainville Drive
36	2357 Tarawa Boulevard
41	Lawn, near buildings, Tarawa School
44	Intersection Frenchman's Creek and dirt road
45	Frenchman's Creek, about 800 yards from confluence W/N.E. Creek (150 yards from creek) (take logging road; soil, edge of clearing)
88	Drainage area about 20 yards behind 2606 Bougainville Drive

* Termite treatment applied about two days previously to No. 388 (Sample No. 11B)
** See No. 88

Appendix A - Continued

OTHER SAMPLES	DESCRIPTION
46	Shoreline water, off outflow, Sewage Lift Station No. 1
47	Ibid, mud
48	Ibid, 20 yards offshore; surface water
49	Ibid, 20 yards offshore; water near bottom
50	Ibid, 20 yards offshore; mud
51	500 yards upstream from Lift Station No. 1; shoreline water
52	Ibid, mud
56	Shoreline water; disposal plant outfall
57	Ibid, mud
58	Ibid, 20 yards offshore; surface water
59	Ibid, 20 yards offshore; water near bottom
60	Ibid, 20 yards offshore; mud
61	Shoreline water, Frenchman's Creek at Northeast Creek
62	Ibid, shoreline mud
66	Frenchman's Creek 800 feet upstream; water
68	Frenchman s Creek and dirt road, water
69	Ibid, shoreline, mud
70	Water, well No. 10
71	Water, well No. 11
72	Water, well No. 9
72a	Plants (cattail) Frenchman's Creek at Northeast Creek
73	Plants (Frenchman's Creek) appr. 800 yards upstream (cattail, perennial grass)
74	Ibid, shoreline mud
75	Filamentous algae, Frenchman's creek at dirt road
76	Ibid, plant composite (moss, cattail, perennial grasses)
77	Sewage Disposal Plant, swamp - plants
78	Sewage Lift Station No. 1 - plants
79	Approximately 800 yards upstream from "78"; plants
80	1615 Cape Gloucester Circle - plants (Plantain, chickweed)
81	Plants - behind Orote Place
82	Plants - low area around 233 Tarawa Boulevard
83	Plants - 3313 Haguru Drive (perennial grasses)
84	Water - approximately 800 yards upstream from confluence of Frenchman's and Northeast Creeks.
85	Ibid, bottom mud
86	Plants - 3369 Haguru Drive
87	Plants - area behind 3265 Agana Place
89	Perennial grass - area behind 2606 Bougainville Drive
90	Perennial grass - area behind 2733 Bougainville Drive

APPENDIX B

DDT and its metabolites p,p'-DDD and p,p'-DDE in samples collected at the Tarawa housing development in December 1965.

Supplemental Tables

Residues of DDT and its metabolites DDD and DDE were also determined as a part of standard pesticide residue analyses conducted at Hazleton Laboratories.

The sensitivity of detection of these insecticides was 0.1 ppm. In cases where a residue value is preceded by the symbol connoting "less than," the sensitivity of detecting residues of DDT and its metabolites was reduced, due to the masking effect of aldrin in chromatographs of the concentrated extracts. Dilutions of the extracts to increase sensitivity of detecting the DDT complex would have reduced sensitivity for aldrin and dieldrin, the insecticides of primary interest.

All water samples contained no detectable DDT, DDD, or DDE; therefore, these samples are not included in these tables.

Table No. 1 - DDT, DDD, and DDE residues in soils and plants, Tarawa Terrace I, dry weight basis.

SAMPLE NUMBER	INSECTICIDE (ppm) DDT REPLICATE			p,p'-DDD REPLICATE			p,p'-DDE REPLICATE		
	1	2	3	1	2	3	1	2	3
1 (1)*	ND****	ND	ND	ND	ND	ND	ND	ND	ND
1 (3)**	ND	ND	ND	ND	ND	ND	ND	ND	ND
2 (1)	ND	ND	<4	ND	ND	<3	ND	ND	1
2 (3)	<***0.4	<0.4	<4	<0.3	<0.3	<3	ND	ND	<1
3 (1)	<4	ND	<6	<3	ND	<3	<1	ND	<2
3 (3)	ND	<6	<6	ND	<3	<3	ND	<2	<2
4 (1)	<0.6	<0.7	<0.9	<0.3	<0.1	<0.3	<0.2	0.2	0.2
4 (3)	<0.6	ND	ND	<0.3	ND	ND	<0.2	ND	ND
5 (1)	ND	ND	ND	ND	ND	ND	ND	ND	ND
5 (3)	ND	ND	ND	ND	ND	ND	ND	ND	ND
6 (1)	ND	<6	<6	ND	<3	<3	ND	<2	<2
6 (3)	<0.6	<6	<6	<0.3	<3	<3	<0.2	<2	<2
8 (1)	4	1	2	0.8	0.2	0.2	1	0.3	0.3
8 (3)	5	ND	0.1	1	ND	ND	1	ND	ND
9 (1)	30	<6	<5	8	<3	<3	10	<2	<2
9 (3)	1	ND	<0.5	0.5	ND	<0.3	0.6	ND	<0.2
10 (1)	ND	<50	<50	ND	<30	<30	ND	<15	<15
10 (3)	<50	<100	<50	<30	<60	<30	<15	<30	<15
11 (1)	ND	<5	ND	ND	<3	ND	ND	<2	ND
11 (3)	<0.5	<5	<200	<0.3	<3	<100	<0.2	<2	<50
19 (1)	<0.5	<0.3	ND	<0.3	<0.2	ND	<0.2	ND	ND
19 (3)	<0.5	ND	ND	<0.3	ND	ND	0.2	ND	ND
21 (1)	ND	ND	ND	ND	ND	ND	ND	ND	ND
21 (3)	ND	ND	ND	ND	ND	ND	ND	ND	ND
47	<0.4	0.1	<0.3	<0.3	0.6	<0.2	ND	0.2	ND
50	<0.3	<0.3	<0.3	0.7	0.7	0.7	0.3	0.2	0.2
52	0.1	0.3	0.1	0.1	0.1	0.1	0.3	0.6	0.3
78	0.2	0.1	0.2	0.4	0.4	0.4	0.2	0.2	0.2
79	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
80	<20	<200	<200	<10	<100	<100	<7	<70	<70
81	10	10	10	0.9	1	1	5	4	4
82	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

* Sample from upper one foot of a three-foot core

** Sample from lower one foot of a three-foot core

*** < - Connotes "less than"; limits of detectability set by masking effect of aldrin in chromatograms

**** "ND" - Not detected; limit of detectability, 0.1 ppm

Table No. 2 - DDT, DDD, and DDE residues in soils and plants, Tarawa Terrace II, dry weight basis.

SAMPLE NUMBER	INSECTICIDE (ppm) DDT REPLICATE 1	DDT 2	DDT 3	p,p'-DDD REPLICATE 1	p,p'-DDD 2	p,p'-DDD 3	p,p'-DDE REPLICATE 1	p,p'-DDE 2	p,p'-DDE 3
22 (1)*	***<100	<5	<0.3	<60	<3	<0.2	<30	<2	ND****
22 (3)**	<5	<0.3	<0.4	<3	<0.2	<0.3	<2	ND	ND
23 (1)	<0.4	<40	<0.4	<0.3	<30	<0.3	ND	<10	ND
23 (3)	<0.4	<0.4	<0.2	<0.3	<0.3	ND	ND	ND	ND
24 (1)	<0.2	<0.4	<0.4	ND	<0.3	<0.3	ND	ND	ND
24 (3)	<0.2	<4	<4	ND	<3	<3	ND	<1	<1
25 (1)	<4	<40	<0.4	<3	<30	<0.3	<1	<10	ND
25 (3)	<0.4	<4	<0.4	<0.3	<3	<0.3	ND	<1	ND
26 (1)	<4	<40	<40	<3	<30	<30	<1	<10	<10
26 (3)	<10	<40	<8	<9	<30	<5	<4	<10	<3
28 (1)	<4	<4	<4	<3	<3	<3	<1	<1	<1
28 (3)	<0.4	<0.4	<2	<0.3	<0.3	<1	ND	ND	<0.6
29 (1)	<7	<7	<7	<4	<4	<4	<2	<2	<2
29 (3)	<0.4	<0.7	<0.7	<0.2	<0.4	<0.4	ND	<0.2	<0.2
30 (1)	<7	<7	<70	<4	<4	<40	<2	<2	<20
30 (3)	<0.7	<70	<70	<0.4	<40	<40	<0.2	<20	<20
31 (1)	<7	<60	<60	<4	<30	<30	<2	<20	<20
31 (3)	<6	<0.6	<6	<3	<0.3	<4	<2	<0.2	<2
31a (1)	<0.6	ND	ND	<0.3	ND	ND	<0.2	ND	ND
31a (3)	ND	ND	ND	ND	ND	ND	ND	ND	ND
32 (1)	<6	<600	<6	<3	<300	<3	<2	<200	<2
32 (3)	<60	<60	<60	<30	<30	<30	<20	<20	<20
33 (1)	<2	<6	<6	<1	<3	<3	<0.6	<2	<2
33 (3)	<0.6	<0.6	<6	<0.3	<0.3	<3	<0.2	<0.2	<2
34 (1)	<6	<40	<40	<3	<30	<30	<2	<10	<10
34 (3)	<4	<4	<0.4	<3	<3	<0.3	<1	<1	ND
35 (1)	<4	<4	500	<3	~~<3~~	10	<1	<1	<1
35 (3)	ND	<0.4	<0.4	ND	<0.3	<0.3	ND	ND	ND
36 (1)	<0.8	<200	<0.8	<0.5	<100	<0.5	<0.3	<90	<0.3
36 (3)	ND	0.6	<0.2	ND	0.10	ND	ND	0.10	ND
41 (1)	3	0.3	<4	<3	ND	<3	<1	0.1	<1
41 (3)	20	<0.4	<4	2	<0.3	<3	8	ND	<1
44	2	0.2	0.2	8	1	2	0.9	0.4	0.3
45	0.3	0.5	0.3	0.1	0.1	0.1	0.1	0.1	0.1
88 (1)	0.6	0.6	0.6	0.4	0.5	0.6	0.1	0.1	0.1
88 (3)	ND	ND	ND	ND	0.1	ND	ND	ND	ND
57	<0.2	<0.2	<0.2	ND	ND	ND	ND	ND	ND
60	0.7	<0.2	<0.2	0.1	0.4	0.9	0.7	0.2	0.6
62	ND	0.1	ND	ND	0.5	ND	ND	0.4	ND
69	ND	ND	ND	ND	ND	ND	ND	ND	ND
74	<0.2	<0.3	<0.3	ND	0.2	0.5	ND	0.1	0.2

Table No. 2 - Continued

SAMPLE NUMBER	INSECTICIDE (ppm) DDT REPLICATE 1	DDT 2	DDT 3	p,p'-DDD REPLICATE 1	p,p'-DDD 2	p,p'-DDD 3	p,p'-DDE REPLICATE 1	p,p'-DDE 2	p,p'-DDE 3
85	<0.3	<0.3	<0.3	0.6	0.7	0.9	0.3	0.3	0.2
72a	<0.2	ND	<1.0	ND	ND	<0.6	ND	ND	<0.4
73	<0.2	<0.2	<0.2	ND	ND	ND	ND	ND	ND
75	0.1	--	--	0.2	--	--	0.1	--	--
76	40	40	60	20	20	20	4	4	4
77	ND	0.3	0.3	ND	<0.2	<0.2	ND	ND	ND
83	0.5	0.6	0.8	ND	0.1	0.1	0.5	0.5	0.8
86	0.6	0.7	0.5	0.6	0.8	0.6	1	1	1
87	3	3	3	0.4	0.4	0.4	6	5	6
89	<20	<40	<40	<10	<20	<20	<7	<14	<14
90	<2	<200	<200	<1	<100	<100	<0.7	<70	<70

* Sample from upper one foot of a three-foot core

** Sample from lower one foot of a three-foot core

*** < - Connotes "less than"; limits of detectability set by masking effect of aldrin in chromatograms

**** "ND" - Not Detected; limit of detectability, 0.1 ppm

Table No. 3 - DDT, DDD, and DDE residues in fish caught in Northeast Creek, wet weight basis.

SAMPLE NUMBER	INSECTICIDE (ppm)								
	DDT REPLICATE			p,p'-DDT REPLICATE			p,p'-DDT REPLICATE		
	1	2	3	1	2	3	1	2	3
F-A	0.13	0.13	0.12	0.75	0.85	0.70	0.58	0.60	0.55
F-B	0.10	0.12	0.09	0.45	0.52	0.72	0.50	0.53	0.45
F-C	0.15	0.16	0.12	0.53	0.60	0.56	0.46	0.48	0.46
F-D	0.10	0.10	0.10	0.34	0.35	0.30	0.35	0.30	0.25
F-E	0.10	0.10	--	0.40	0.43	--	0.42	0.42	--
F-F	0.10	0.10	--	0.49	0.35	--	0.43	0.31	--
F-G	0.05	0.05	--	0.11	0.11	00	0.20	0.21	--
F-H	ND	ND	--	ND	ND	--	ND	ND	--
F-I	ND	ND	--	0.28	0.30	--	0.31	0.33	--

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Office of Naval Research

13. ABSTRACT

A study was conducted to determine residues of termite control insecticides aldrin and dieldrin in the environment of the Tarawa Terrace housing development at Camp LeJeune, North Carolina in December 1965.

Samples of soils, water, plants, fish, and algae were obtained for residue analysis by means of electron capture gas chromatography and thin layer chromatography.

There was no direct relationship between levels of aldrin and those of dieldrin (the epoxide of aldrin) in a given soil sample. When the residue levels of aldrin, as well as dieldrin, were compared between upper and lower soil profiles, no definite leaching gradient could be observed. It is necessary that soil samples be obtained from greater depths to provide a better evaluation of leaching.

Insecticide residue levels in general were highly variable. Soils and plants within the treatment area generally contained high levels of aldrin and/or dieldrin and those outside of the treatment area, particularly downgrade toward nearby creeks, were generally free of these insecticides. A sample of filamentous green algae taken from the headwaters of Frenchman's Creek contained low levels of aldrin and dieldrin, but higher plants, soils, and water taken from this area contained no detectable residues of these insecticides. No other aquatic microorganisms were obtainable.

Water taken from wells in the termite treatment area and from two nearby creeks contained no detectable aldrin or dieldrin.

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14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
1. Termite Insecticide Residues	-	-	-	-	-	-
2. Environmental Distribution of Termite Insecticides	-	-	-	-	-	-
3. Chemical Analysis	-	-	-	-	-	-
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Abstract - Cont'd.

Flounder caught in Northeast Creek contained no detectable aldrin or dieldrin.